2011

Osler and the Infected Letter: A History of Disinfecting Mail with Special Reference to Smallpox

Charles T. Ambrose
University of Kentucky, cambros@uky.edu

Osler and the Infected Letter: A History of Disinfecting Mail with Special Reference to Smallpox

Notes/Citation Information
Published in *The Persisting Osler--IV: Selected Transactions of the American Osler Society 2001-2010*. Jeremiah A. Barondess & Charles S. Bryan, (Eds.). p. 77-86.

Osler and the Infected Letter: A History of Disinfecting Mail with Special Reference to Smallpox

Charles T. Ambrose, M.D.

In January 1876 William Osler, a young Canadian physician, was recovering from a mild case of smallpox contracted while attending patients at the Montreal General Hospital (Figure 1). In a letter written that same month to an old schoolmate (Arthur Jarvis), Osler described his illness and noted in closing, "You need not be afraid of this letter. I will disinfect it before sending."[1] Concern about disseminating smallpox via the letter was well founded. In his medical textbook of 1892, Osler would later write that smallpox can be conveyed by fomites: "the dried scales [of variola scabs] . . . as a dust-like powder . . . become attached to clothing and various articles. . . ."[2] The purpose of this paper is to review briefly the history of disinfecting mail, a topic of renewed interest following the 2001 anthrax-mail scare in this country.

Stability of the Smallpox Virus

Long before Osler's time, the stability and infectivity of variola virus was well known, as illustrated by an example of germ warfare during the French and Indian War. In 1763, the British general, Sir Jeffrey Amherst, ordered that scab-

Presented at the thirty-second annual meeting of the American Osler Society, Kansas City, Missouri, on April 24, 2002.

This paper was previously published in *Emerging Infectious Diseases* (2005; 11: 689–93) and is reproduced with permission.

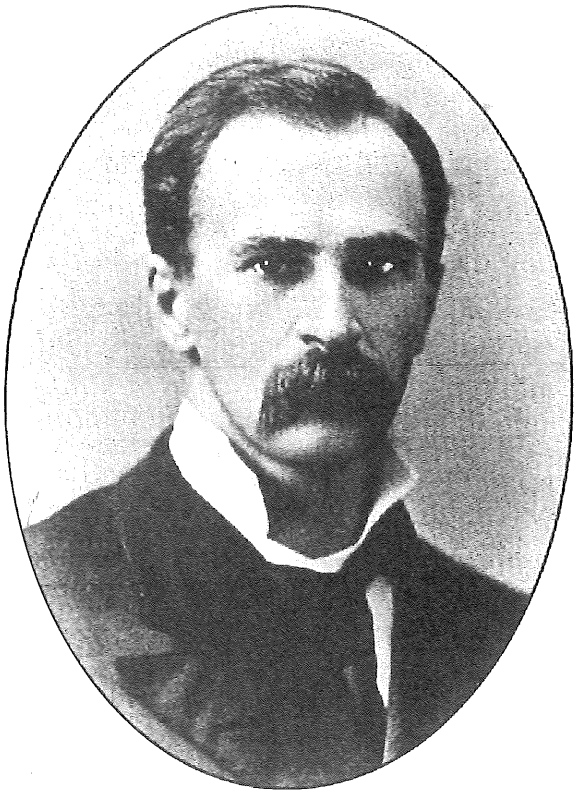

Figure 1. William Osler, age 28, 1877. From Golden and Roland.[27]

laden "Sundries" be delivered to the Ottawa Indians of Pennsylvania, hoping thereby to induce a debilitating smallpox epidemic among them and to obtain their conquest.[3]

Much later, in the 1860s, a professional grave robber for the Medical College of Ohio in Cincinnati became incensed at tricks played on him by medical students. He delivered the corpse of a smallpox victim recently buried to the dissecting laboratory, and intentionally infected many anatomy students.[4]

The stability of the smallpox virus was often noted by eighteenth century doctors in debates over the comparative merits of variolation and vaccination. Razzell cited a 1792 article describing how an English amateur inoculator dried smallpox scabs in peat smoke, stored them underground covered with camphor, and used them as long as eight years later.[5]

Razzell also reported the longest supposed survival of the variola virus, which caused an outbreak of smallpox in a town in Somerset in 1759. The coffin of a villager who had died of smallpox thirty years before was exhumed for transfer to a new grave site. The sexton accidentally put his spade through the oak coffin, which released "a most nauseous stench." The deceased was of such eminence that most of the villagers had attended the exhumation and re-burial. "In a few days afterwards, fourteen persons were seized with smallpox in one day."[5]

Today we would be skeptical of this story from eighteenth century Somerset, since outbreaks of smallpox appeared occasionally in other isolated communities in England without any recognized living human source. For example, between 1908 and 1952 sporadic cases of variola appeared in Lancaster and Cheshire, textile mill counties. These outbreaks were likely introduced there by

cotton imported from Egypt, where months before it had been contaminated with smallpox scabs.[6]

Samples of smallpox virus freeze-dried in a laboratory have been revived after storage for twenty years at Liverpool University,[5] but long-term survival of the virus under natural conditions is another matter. In 1957, two London virologists, using cell cultures, examined smallpox scabs stored in test tubes under ambient laboratory conditions. They found that variola virus survived as long as eighteen months.[6] A comparable study from Leiden in 1968 used variola minor scabs collected and stored in a dozen unsealed envelopes kept at room temperature. Each year the contents of a single envelope were cultured. The final envelope was examined thirteen years later and, like the previous ones, showed virus particles still capable of replicating in culture.[7]

The search for variola viruses surviving even longer was pursued in 1991 near Novosibirsk, Russia.[8] "Bioweapons experts" searched for the variola virus in nineteenth-century century smallpox victims mummified in the permafrost above the Arctic Circle. The threat then was that these corpses might become exposed because of unusual thawing and flooding and might release infectious virus into the neighborhood. In the nineteenth century this region of Russia (Sakha Republic) was "ravaged by smallpox strains of extraordinary lethality." Isolating and comparing them with preserved modern strains might identify genes contributing to virulence. To date, no live variola viruses have been isolated. But the threat now is that "a sophisticated terrorist team might . . . go smallpox hunting on the permafrost."[8]

Smallpox Transmitted via Letters

In 1876, Osler's concern was the danger his letter might pose to his friend, Arthur Jarvis. Indeed, years later in 1901, articles in two respected medical journals incriminated letters as sources of two separate epidemics of smallpox:

The *New York Medical Journal* reported that a young lady in Saginaw, Michigan had developed smallpox after receiving a letter from her sweetheart, a soldier in Alaska. He had written it while recovering from the disease. The infection subsequently spread to 33 other people in Saginaw.[9]

Also, the April 1901 issue of the *British Medical Journal* reported an outbreak of five cases of smallpox at the Mormon headquarters in Nottingham, England apparently after receipt of "letters or other fomites" from Salt Lake City, Utah, where smallpox was widespread.[10] According to the "Medical News" in the *Journal of the American Medical Association* of February 1901, 314 cases had been reported over the previous three months in Salt Lake City itself.[11] The year before, the *New York Times* noted that Mormons opposed vaccination and had introduced a bill in the state legislature making it unlawful to compel vaccination.[12]

Other Fearsome Epidemics

In the fall of 2001, Americans were terrorized by the anonymous distribution of anthrax spores in letters. This resulted in eighteen confirmed cases of the disease, five deaths, and contamination of perhaps 5,000 letters.[13] Not since the fifth plague of Egypt, which may have been anthrax ("a very grievous murrain,"

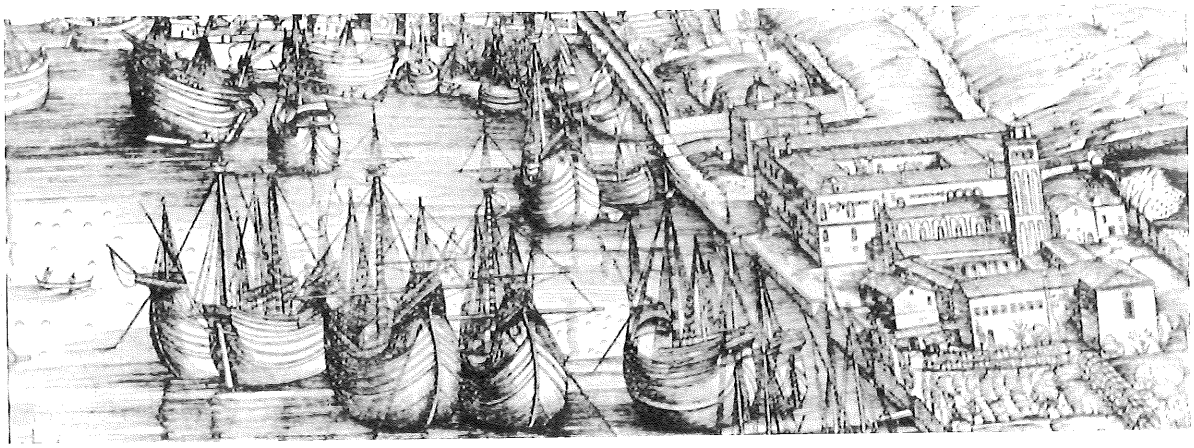

Figure 2. Ships docking at the *Lazzaretto Vecchio*, Venice, fourteenth century. From Links.[18, p. 133]

Exodus 9:3), have people so panicked over the threat of this disease, although, in centuries past, many have fled from the sudden appearance of five contagious diseases: smallpox, bubonic plague, yellow fever, typhus, and cholera. At times relapsing fever and dysentery were also of concern.[14] Malaria, however, was such an expected seasonal affliction in many part of the world that it was never perceived as an acute contagion.

When a smallpox epidemic struck Rome around 164 A.D., Galen is said to have hastily returned to his home in Pergamon on the Ionian Coast of present-day Turkey. When plague returned to London in 1665, Dr. Thomas Sydenham prudently sought safety in the countryside. In 1793, yellow fever swept through Philadelphia, then our federal capital. Alexander Hamilton left town and President George Washington remained at Mount Vernon until the fall frost up north had been reported. In 1813, typhus decimated the French army in Moscow, forcing Napoleon to retreat back to Paris, and in 1832, when cholera came to Kentucky, U.S. Senator Henry Clay established a tent city on his estate outside Lexington for 2000 citizens who fled the town's miasmas.

Origin of Quarantines

In the fourteenth century, most citizens could not flee pestilences threatening their towns, and so civil authorities sought to protect them by excluding suspected human carriers and merchandise from outside. Garrison gives a succinct history of early quarantines.[15] When bubonic plague reached Europe in 1347, ports on the Mediterranean and Adriatic Sea were among the first to deny entry to ships coming from pestilential areas—notably Turkey, the Middle East, or North Africa. Florence, on the Arno River, issued restrictions on travelers and goods as early as 1348. The Venetian Republic formally excluded "infected and suspected ships" in 1374.[15] The earliest such action in the Americas was by the Massachusetts Bay Colony in 1647–1648, when it barred ships coming from the West Indies thought to be carrying yellow fever.[16]

The first official quarantine system is commonly ascribed to Ragusa (now called Dubrovnik), a port city located on the Dalmatian coast of the Adriatic Sea. There in 1377, and later, when pestilences were abroad, incoming people and ships were first isolated on a nearby island for thirty days (*trentina*) to await clinical signs of a contagion or evidence of continued good health. Detention of forty days (*quarantina*) was instituted by the city of Marseille in 1383 and soon became the standard period of quarantine.

Later, other cities established isolation stations on shore or on nearby islands. Ragusa's use of an offshore island in 1377 was an early example of such a quarantine station. In spite of Ragusa's seeming priority, various sources claim that the first such station was a pest house built on the island of Sardinia in 1453 or buildings erected at Pisa near the church of San Lazzaro in 1464.[14,15] In North America during the 1743 epidemics of smallpox and yellow fever, an early quarantine station was established in Philadelphia on Providence Island in the Schuylkill River.[17] Other major U.S. cities soon thereafter organized quarantine stations to cope with later epidemics of smallpox, yellow fever, typhus, and cholera.

Lazarettos

Quarantine stations in southern Europe were originally called lazarettos. The origin of the term is uncertain. One nineteenth-century historian suggested that it is a corruption of the name of the church of Santa Maria di Nazaret, used as pest house in fifteenth-century Rome,[17] but the Crusaders, who captured Jerusalem in 1099, had isolated and treated people with contagious diseases outside the city in the Hospital of St. Lazarus, the patron saint of lepers.[14] In 1403, quarantined ships in Venice were anchored at the Lazzaretto vecchio, an island in the lagoon (Figure 2). When the island acquired this particular name is not known. As noted above, in Pisa (1464) people were quarantined in a special building near the Church of San Lazzaro.[15] An exhaustive, illustrated survey of lazarettos is given in John Howard's 1789 treatise, *An Account of the Principal Lazarettos in Europe* (Figure 3).[19]

Early Decontamination Measures

During the early Renaissance, clothing and other possessions of plague victims were often burned. In Italy and France during this period, the threat of plague compelled the destruction of great quantities of cloth prepared from cotton, wool, and silk recently imported from suspect countries, resulting in enormous economic loss and often in devastating local poverty.[20]

The earliest attempts to decontaminate merchandise on ships coming from pestilential shores were made in Venice in the mid 1400s. Cargo was unloaded and fumigated with smoke from burning straw, pitch, tobacco, or even gunpowder. Cargo was also "perfumed." This term likely derived from burning fragrant herbs, juniper berries, aromatic gums (e.g., myrrh), and resinous wood in attempts to sterilize items. Smoking sulfur was frequently employed, while in eighteenth-century Germany a mixture of sulfur, potassium nitrate (saltpeter), and wheaten bran (*Raucher Pulver*) was used.[17]

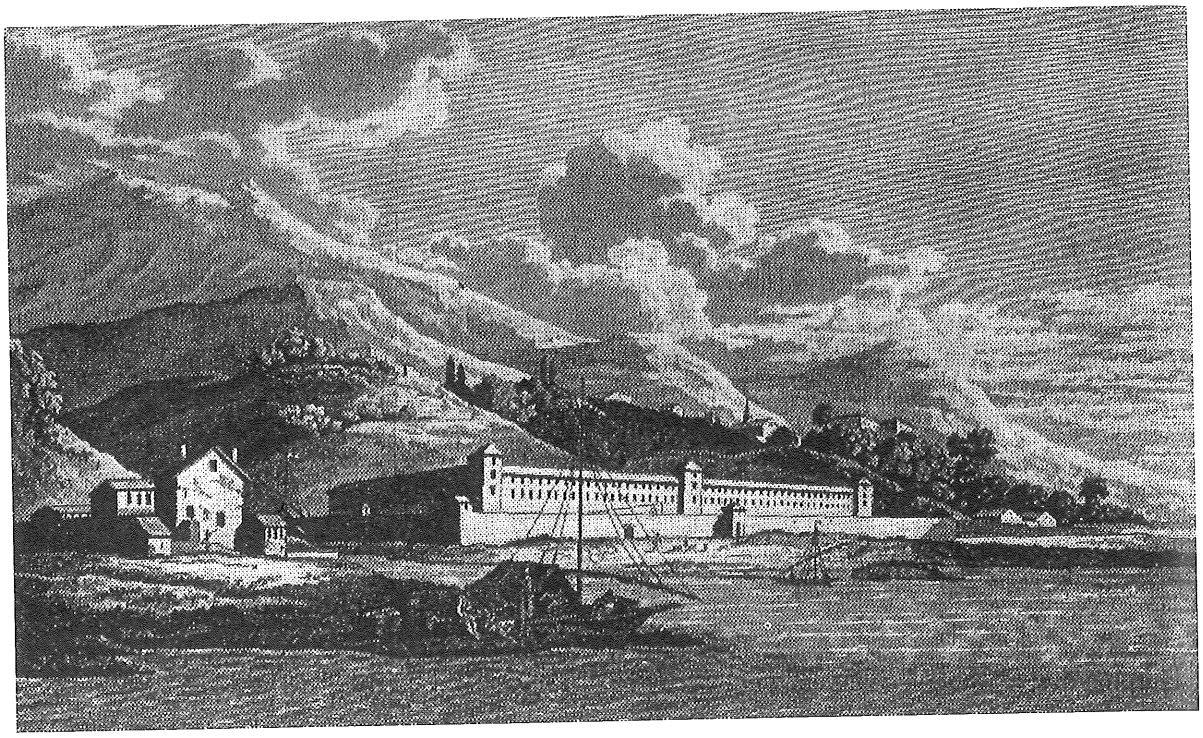

Figure 3. Lazaretto at Genoa, founded in 1467.
From Howard.[19, opposite p. 6]

Disinfection of Mail

Dr. Karl F. Meyer of Louisville, Kentucky spent a lifetime researching the history of disinfection of mail.[17] He determined that this was first attempted in Venice around 1493 by dipping letters in vinegar. Later, other methods were employed. By the early 1600s decontamination of mail was practiced in much of Europe. In the United States in 1712, when yellow fever threatened Boston, mail from docking ships was first exposed to burning sulfur.[14]

Very few letters from the early centuries of mail decontamination are available today, but one rare specimen from 1485 does show evidence of having been dipped in vinegar.[17] Since such treatment often rendered parts of the letter illegible, other less damaging methods were employed, such as exposure to smoke and various fumes. The eventual widespread use of burning sulfur, yielding sulfur dioxide (with its "sharp, irritating odor") may have been based on an ancient idea that the more foul a medicine, the more effective it might be.

In the late nineteenth century, sulfur gave way to chlorine or formaldehyde gas. In November 2001, chlorine dioxide gas was sprayed into the "partly contaminated Hart Senate Office Building," while the Postal Service used a 10 percent solution of bleach to "sterilize" its mail sorting centers.[21] Ion beam sterilization (high-energy electrons) and X-ray radiation have been considered for use on individual letters.[22]

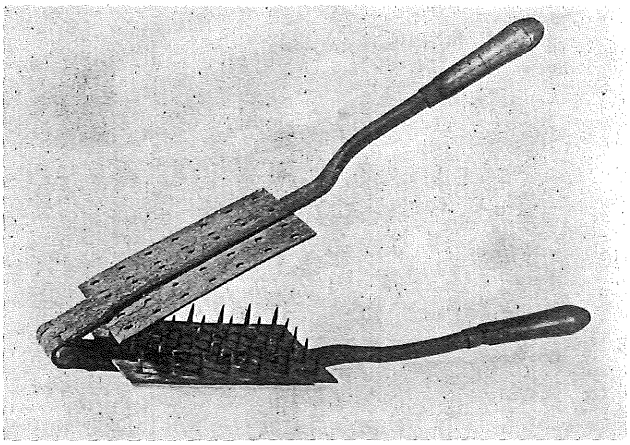

Figure 4. Rastel, a perforating mallet, circa 1830.
From Howard.[9, p. 152]

Decontaminating Letters "Inside & Outside"

Sterilizing the outside of sealed envelopes did not insure that the letter inside was safe. To allow penetration of sterilizing fumes or gases, initially envelopes were breached by cutting a small tip off one or more corners without exposing the content of the letter inside. In later years multiple small holes were made in the envelope and its letter by means of a rastel—a hair brush-size instrument consisting of two hinged metal plates (jaws), one of which held several rows of nails or small metal spikes (Figure 4). Clamping each letter between the jaws of the rastel produced several rows of small holes through envelope and its content, enabling gas to penetrate the interior.[17]

When thousands of letters required fumigation, perforating each one individually was not practical. Instead, they were merely laid out on screens, placed in air tight boxes (or in a box car), and exposed to burning sulfur over a period of six hours or so (Figure 5). Sterilizing the outside of envelopes protected the mail handlers, but the reader still remained at risk from the contents.

Certification of Decontamination

Once decontamination of letters had been performed, some sort of certification had to be noted on them. As late as 1837, a paste or wax seal was affixed to fumigated letters. But this was impractical with large numbers of letters; so soon each letter was simply stamped, much like a modern day postal cancellation. The following are short word descriptions of these cancellation marks taken from illustrations of some early nineteenth century cachets in Dr. Meyer's 1961 book (Figure 6).[17]

A letter which had passed through Genoa in 1813 during the Napoleonic occupation bore the French stamp *Purifié à Gènes.* Letters stamped at Leghorn in 1829 showed *LAZZERETTO SAN ROCCO DI LIVORNO.* San Rocco was one of the two plague saints. (Saint-Sébastien was the other.) During the early period when only

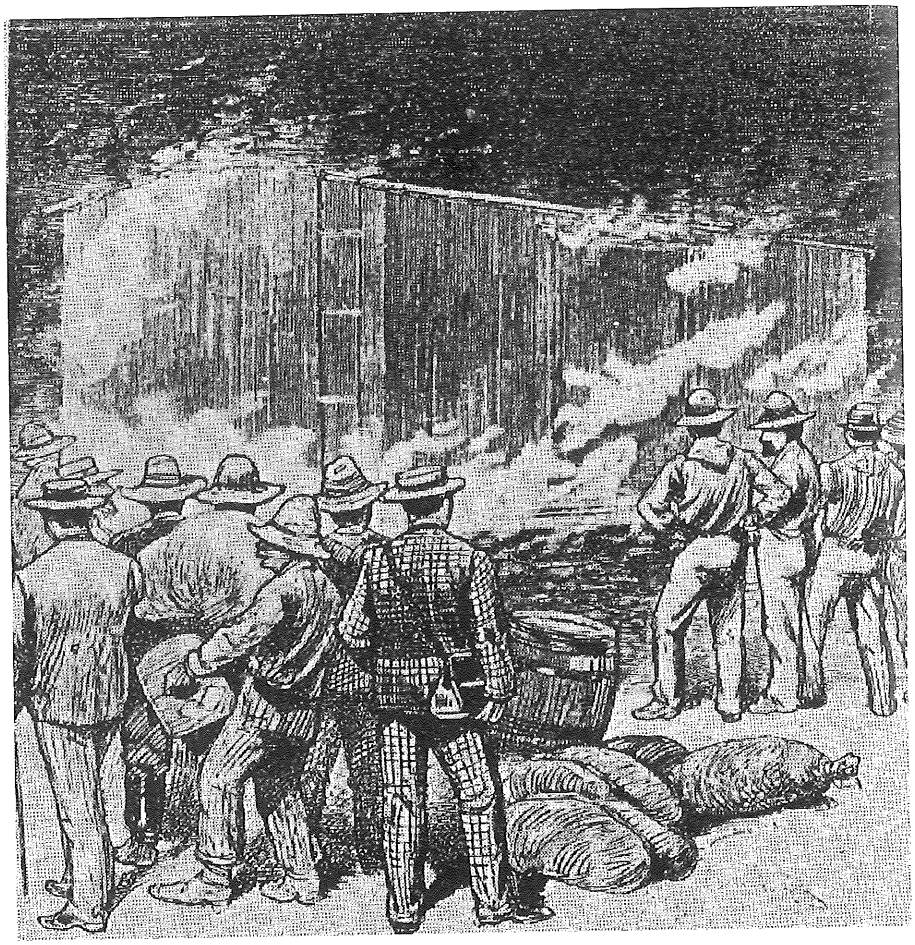

Figure 5. Fumigating mail in a box car, late nineteenth century. From Meyer.[17, p. 313]

Figure 6. Various cachets from nineteenth-century envelopes. A. Genoa, 1813. B. Austria, 1830–1869. C. Vienna, 1831–2. D. Papal insignia.
From Myer.[17, p. 82, p. 83, p. 137, p. 222]

the outside(s) of envelopes were disinfected, an Italian cachet read *NETTA FUORAI E SPORCA DENTRO*, or "clean outside and dirty inside." An 1830 cachet with the Papal insignia noted *NETTA DENTRO E FUORI* (clean inside & out). An 1831 stamp from Vienna read *Rein von innen und aussen* (clean within & out). A first class letter from Jacksonville, Florida in 1888 read simply "Fumigated" and thus did not define the extent of the procedure.

The Decline in Disinfection of Mail

By the early twentieth century, it was accepted that plague, typhus, and yellow fever are transmitted by arthropod vectors and that cholera is water-borne. Letters seemed an unlikely means of spreading pestilences; so disinfection of mail declined. But some authorities continued to see a potential risk in mail from patients with tuberculosis and leprosy. Dr. Meyer noted that as late as 1953 letters leaving a German tuberculosis sanatorium were first fumigated with formaldehyde fumes. Likewise in the United States, as late as 1968 mail leaving the leprosarium at Carville, Louisiana was first sterilized by baking in electric ovens.[17]

Conclusions about Osler's Letter

In his 1876 letter to Arthur Jarvis, Osler did not say how he would disinfect it. The letter shows no vinegar stains. The sterilizing value of dry heat (oven) and moist heat (autoclave) was not established until 1881, by Koch and others.[23] The causative agent of smallpox was not visualized microscopically until 1887, when Buist first observed in infected tissues small clumps of virus particles now called Guarnieri bodies. The variola virus was first cultivated in 1935 by Torres and Teixeria on the chorioallantoic membrane of embryonated eggs.[24]

As a pathologist, Osler may have used formaldehyde vapors to sterilize his letter. In any case, we do not hear that Jarvis ever contracted smallpox from it. Indeed, correspondence between Osler and Jarvis continued at least through 1910.[25] Osler died in 1919 and Jarvis in 1936.[26]

References

1. Cushing H. *The Life of Sir William Osler.* London: Oxford University Press; 1940: volume 1: 143.
2. Osler W. *The Principles and Practice of Medicine.* New York: D. Appleton & Co.; 1892: 47.
3. Fenn EA. *Pox Americana, the Great Smallpox Epidemic of 1775–82.* New York: Hill & Wang; 2001: 88–9.
4. Juettner O. *Daniel Drake and His Followers.* Cincinnati: Harvey Publishing Co.; 1909: 395.
5. Razzell P. Smallpox extinction—a note of caution. *New Scientist* 1976; 71: 35.
6. MacCallum FO, McDonald JR. Survival of variola virus in raw cotton. *Bulletin of the World Health Organization* 1957; 6: 247–54.

7. Wolff HL, Croon JJAB. The survival of smallpox virus (variola minor) in natural circumstances. *Bulletin of the World Health Organization* 1968: 38: 492–3.
8. Stone R. Is live smallpox lurking in the Artic? *Science* 2002; 295: 2002.
9. A letter blamed for an epidemic of small-pox. *New York Medical Journal* 1901; 73: 600.
10. Boobbyer P. Small-pox in Nottingham. *British Medical Journal* 1901; 1: 1054.
11. Medical News. *Journal of the American Medical Association* 1901; 36: 333, 453.
12. Smallpox in the West. *New York Times* 22 January 1900: 2.
13. Gugliotta G. Study posits anthrax in 5,000 letters. *International Herald Tribune* 15 May 2002 (from *The Washington Post*).
14. *The American Cyclopaedia.* New York: D. Appleton & Co.; 1879: volume XIV: 127–8.
15. Garrison FH. *An Introduction to the History of Medicine.* Fourth edition, Philadelphia: W.B. Saunders Co.; 1929: 188.
16. Pearson EF, Miles W. Disinfection of mail in the United States. *Bulletin of the History of Medicine* 1980; 54: 111–19.
17. Meyer KF. *Historical Review and Tentative Listing of Cachets, Hand Stamp Markings, Wax Seals, Wafer Seals and Manuscript Certifications Alphabetically Arranged According to Countries.* Holton, KS: The Gossip Printery, Inc; 1962: 20–3 (Library of Congress Card 62-15592).
18. Links JG. *Venice for Pleasure.* Fifth edition, London: Moyer Bell; 1995: 133.
19. Howard J. *An Account of the Principal Lazarettos in Europe; with various papers relative to the Plague.* Warrington [United Kingdom]: Wm. Eyree; 1789.
20. Cipolla CM. *Public Health and the Medical Profession in the Renaissance.* Cambridge, MA: Cambridge University Press; 1976: 41–3.
21. Revkin AC. Seeking a workable solution in theories of decontamination. *New York Times* Service, in *International Herald Tribune,* 8 November 2001.
22. Florig HK. Is safe mail worth the price? *Science* 2002; 295: 1467–8.
23. Wilson GS, Miles AA. *Topley and Wilson's Principles of Bacteriology and Immunity.* Baltimore: The Williams & Wilkins Co.; 1955, volume 1: 129.
24. Rivers TM, Horsfall FL. *Viral and Rickettsial Infections of Man.* Third edition, Philadelphia: J.P. Lippincott Co; 1959: 679–80.
25. Two letters from William Osler to Arthur Jarvis, dated 1910 (in the possession of the author).
26. Russell L [Diocesan Archival Technician, The Diocese of Ontario], personal communication, 27 March 2002.
27. Golden RL, Roland GG, editors. *Sir William Osler, An Annotated Bibliography with Illustrations.* San Francisco: Norman Publishing; 1988: 22.